DOCUMENT RESUME

ED 179 193 IR 007 854

TITLE	Computers in Public Education Study.
INSTITUTION	HBJ Enterprises, Highland Park, N.J.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
REPORT NO	WLC-E-79-3
PUB DATE	3 Aug 79
NOTE	39p.
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Computer Assisted Instruction; Computer Managed Instruction; *Computers; Electronic Data Processing; Elementary Secondary Education; Equipment Manufacturers; *Public Schools; Surveys; *Use Studies

ABSTRACT

This survey conducted for the National Institute of Education reports the use of computers in U.S. public schools in the areas of instructional computing, student accounting, management of educational resources, research, guidance, testing, and library applications. From a stratified random sample of 1800 schools in varying geographic areas and population centers, a response rate of 12.7 percent was obtained. This information, coupled with the manufacturer's own assessment of sales to the "educational market," formed the data for the study. Analyses of these data indicate programming languages used, sources of funding, types of computers, size of installation, costs, number of users, software used, attitudes toward computer usage, computer sales, and increased computer usage by state. (RAO)

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AUGUST 3, 1979

COMPUTERS IN PUBLIC EDUCATION STUDY

PREPARED FOR:

THE NATIONAL INSTITUTE
OF EDUCATION (NIE)

UNDER PROJECT NUMBER:
NICD #28-16

REPORT WLC-E-79-3

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IR007854

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ABSTRACT

1979 Computers in Public Education

Computers are increasingly being used in U.S. public schools for Testing and Student Administration, Data Processing curriculum, and Computer-Assisted and Computer-Managed-Instruction.

A survey conducted by HJB Enterprises of Highland Park, New Jersey for the National Institute of Education found that overall, (apart from payroll and other such staff related applications), about 15% of all U.S. public schools are using computers for applications directly associated with students!

The most prominent use is at the High School level in association with student accounting, the management of educational resources, research, guidance, testing and library applications. Indeed, 78% of all U.S. high schools are using computers to some degree for these purposes. Another increasing use, at this level, is teaching Data Processing via "hands-on" approaches at the High Schools. Some 28% of the schools sampled are now offering elective instruction in Electronic Data Processing and Computer Programming.

Finally, about 5.9% of all U.S. public schools are using computers to some degree for Computer-Assisted or Computer-Managed-Instruction. In all, it is estimated that over 20,000 educational computer systems are now functioning in the U.S. public schools.

The study was based on a nationwide sample of educational computer activities in some 1,800 schools, and was corroborated with data provided by computer system manufacturers. The results also corroborates

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well with data from previous studies including those conducted by HJB Enterprises, which were presented at the October, 1977 "Computers and the Learning Society" hearings before the U.S. House of Representatives Committee on Science and Technology!

The survey indicated that a dramatic change in attitude towards computer involvement has occured over the past nine years. Whereas, in 1970, those schools without computers generally expressed "no interest" in them, in 1979, only 13% of the school districts without computer involvement still maintained a "no interest" position. The other 87% of the schools feel that they are "planning to have them, at some time in the future." This change in attitude has been partly motivated by the appearance of more cost-effective, "micro-processors", and lower cost peripherals, and more general appreciation of the need for the students to be "computer literate" to function well in the 21st century!

Another interesting statistic is that the funding for these programs is coming from the Local Districts in about 70% of the cases. (In some classrooms the teachers themselves, are purchasing low price units with their own money!) The Federal Government is only funding about 20% of the installations, and State Governments about 10%, with Minnesota, Oregon, and Michigan among the leaders. Schools are spending about 20¢ on computer use for each $100 total spent, (includes teachers salaries) or about 3.5% of the total of the Instructional Materials budget.

In the instructional areas, the two most frequent applications are for teaching Mathematics (49%) and for teaching Computer Science (21%) itself. The other important subject areas are: Science (14%), Reading and Languages (9%), Social Sciences (5%), Independent Work

and research (4%), Business Education (4%), Vocational Areas (3%), Guidance (2%), and Miscellaneous Courses (2%).

There are several different modes of application. Of the total usage, the "hands-on" teaching about computers and data processing accounts for 25%, and Drill and Practice usages, for 28%; however, tutorial CAI accounts for some 20% of the applications, and Problem Solving for 27% of the applications. There are also overlapping uses for Simulations, and Testing and Computer-Managed-Instruction.

Depending on the nature of the school application mode, where computer systems are active, average student involvement generally occupies from 5% to 15% of total weekly classroom time.

The students are learning several programming languages such as: BASIC (60%), FORTRAN (20%), COBOL (10%), (predominating!), and also some minor involvement with PL/1, ASSEMBLY, PASCAL, and such machine languages as NEAT, PAL, APL, and RPG.

There is increasing shift towards purchase of Mini- and Micro-Computing Systems. Some 6,000 of all types of these units and terminals found their way into American Schools in the past academic year, representing an annual total commercial market of about $70,000,000. Units are generally purchased, but in some cases leased, or rented. At present the average school has only about four terminals, or personal computers. Some of the leading equipment suppliers were: Digital Equipment Corporation, Hewlett-Packard, Honeywell, Data General, Control Data Corporation, NCR, IBM, Burroughs, Univac, and Tandy/Radio-Shack, Commodore, Texas Instruments, Apple, Wang, IMSAI, Ohio Scientific, and Tektronix. In the HJB Enterprises study, data from both the school districts and manufacturers were correlated.

Most of the schools involved use software and courseware provided

by the system manufacturers, however in increasing numbers, consortium developed, and school developed software and courseware is being used.

There is a fairly high correlation between schools with computer systems involvement, and with schools also utilizing Audio-Visual, Television (direct Public TV, and Closed Circuit), and Teaching Machines.

Most of the schools feel that there is a need for Federal Support in conjunction with system expansion, and the Training of Teachers in Computer Literacy and Computer Systems know-how! At present such training is very limited and being done with local and personal funds.

Manufacturers are also in agreement with Government Support, but are increasingly concerned with possible negatives associated with Federal Regulation activities. They feel the "implementation time" has arrived!

States with significant computer use in educational institutions include: New Hampshire, Massachusetts, Connecticut, New York, New Jersey, Washington, D.C., Pennsylvania, Ohio, Michigan, Wisconsin, Illinois, Minnesota, Iowa, Kansas, Maryland, North Carolina, Florida, Texas, Virginia, California, Oregon, Utah, Colorado, Arizona, Hawaii, and Alaska.

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I. Introduction

In March, 1979, HJB Enterprises undertook the responsibility of determining an estimate of educational computer use in the nation's public schools for the National Institute of Education (NIE). The need for such a study partially grew out of the involvement of NIE in studying testing methodologies in the U.S. public schools.

The primary method of acquisition of data about the nature and extent of computer usage was by a questionnaire directed to school principals. In some cases follow-up telephone calls, and visits were also made.

Our study began with a stratified, random sample of 1,800 separate schools; this total, N, was drawn from a cross-section of the nation's geographical areas with varying degrees of population densities. Only 12.7% of the schools responded directly with answers to most of the questionnaire items. However, for the purpose of extent of usage, a "no response" was considered as a "no-involvement" with computers for educational CAI/CMI use.

Independently, the study investigated the use in public schools via the manufacturer's own assessment of sales to the "education market". Letters were sent, and telephone calls were made to about 40 leading manufacturers and/or marketers of computers. Although about half of the companies were reluctant to share market data, there was general interest in the study, and overall, there was enough feedback to provide a separate estimate of usage in the nation's public schools. Copies of representative letters sent to the participating schools and manufacturers can be found in Appendicies to this report. Also included are relevant data, tables, and breakdowns of information about the U.S. public school system, from grades K through 12.

II. Instructional Computing

Our survey reveals that the use of computers for educational purposes is becoming an increasingly common phenomenon. There has been a decided shift in the past few years towards utilization of mini-computer, and microcomputer systems; 46% of our respondents indicated that there was some use of computer technology for educationally related activities. Closer scrutiny of the data reveals that significant patterns of application are emerging.

Ten years ago, computers in education were met by skepticism and anxiety. In many instances, they were perceived as a potential threat to instructors, and the first step towards dehumanization of the educational process. The present study indicates that this stereotype has greatly weakened. Of the schools responding, only 13% of the schools without computer systems applications still feel strongly negative about them. The majority of the schools without educational computer applications now feel that they are "planning to have them at some time in the future." Contributing to this change in attitude has been a more general appreciation of the need for students to be "Computer Literate" to function well in the 21st century, and the appearance of more cost-effective, "personal" computers with lower cost peripheral equipments. Many of the replies from schools with "no anticipated computer involvement" cited "budget constraints" as the inhibiting factor.

Patterns of usage are starting to emerge. For example, educational computer use in the nation's public schools predominates at the high school level where 78% of all secondary schools are using computers to some degree in association with student accounting, the management of educational resources, testing, research, guidance, and library applications.

Ten years ago, less than 30% of all public high schools utilized computer technology for educational purposes! It is also apparent that once computer technology is introduced, even when its initial use is narrowly centered around such items as management of resources, the areas of its application tend to increase, and over a period of several years, applications for research, testing, and student accounting tend to develop.

At the high school level the next area of greatest use tends to be for the teaching of Data Processing via "hands-on" approaches. Some 28% of the schools in our sample who responded indicate that they are now offering elective instruction in such areas as Computer Programming, Electronic Data Processing, and Computer Applications.

The utilization of educational computers at the elementary school level tends to be "smaller, but more pure". Taken as a total group about 5.9% of all U.S. public schools are using computers to some degree for computer-assisted-instruction (CAI) or computer-managed-instruction (CMI). Extrapolation indicates that over 20,000 educational computer systems are now functioning in the nation's public schools. Though there is considerable variety of use and forms of installation, our survey found that most micro-processor installations are for instructional purposes. Though a large number of additional schools utilize computers administratively, often these are relatively older systems, now associated with the entire school's record keeping fuction. Only 10% of our sample indicated that recently purchased computer systems were being used for administrative purposes only.

Our study found a strong relationship between use rates and certain curriculum areas. In the instructional applications area, the two most frequent applications are for teaching Mathematics (49%), and for teaching Computer Science itself (21%). The other important subject area are: Science (14%), Reading and Languages (9%), Social Sciences (5%),

Independent Work and Research (4%), Business Education (4%), Vocational Areas (3%), Guidance (2%), and Miscellaneous Courses (2%).

There are several different modes of application. Of the total instructional usage, the "hands-on" teaching about computers and data processing accounts for 25%, and Drill and Practice usages, for 28%; however, Tutorial CAI accounts for some 20% of the applications, and Problem Solving for 27% of the applications. There is additional separate use for Simulations (10%), and Testing and Computer-Managed-Instruction, (14%).

Depending on the nature of the school application mode, where computer systems are active, average student involvement generally occupies from 5% to 15% of total weekly classroom time.

A mere accounting of the breakdown of courses using computers does not allow us to see some of the special efforts being made with this new instructional device. Remedial programs, classes for the gifted, career training programs including internships, and ongoing explorations for future educational alternatives, are all part of the new approach.

Testing is recognized as a crucial facet of associated evaluation programs, and pre and post-tests have generally become an intergral part of educational computer use. Schools which use instructional computers have a strong awareness of the value of educational accountability. In addition to the built-in "criterion reference tests" associated with the educational computing usage, these schools often use norm-referenced tests such as the Iowa Test of Basic Skills to assist in the evaluation of student progress.

While only about 14% of schools using computers for education have full CMI use, many of the schools make some use of the computer system for testing and record keeping. Accordingly, a number of respondents indicated that the use of computers has allowed them to provide more individualized attention to their students and more time for creative activity in the classroom.

III. Programming Languages

Though our questionnarie did not directly solicit information about programming languages, it was frequently volunteered in conjunction with reports on software use. While, it is difficult to reach specific quantitative conclusions about the overall popularity of specific languages, they are listed below in order of their apparent degree of use:

Software Language	Use Estimate	
BASIC	about 60%	predominating
FORTRAN	about 20%	
COBOL	about 10%	
PL/1		
ALGOL		
FOCAL		
ASSEMBLY		
PASCAL		
APL		
NEAT		
PAL		
RPG		

IV. Sources of Funding

Most responding schools indicated that local funds were used for initial acquisition and for any expansion of educational computer systems. We found that Local funds were employed about 70% of the time. Since this is the case, the impact of greatly reduced budgets and staff cutbacks are felt severly in this relatively new developmental area. For example, Sutter Junior High School in Winnetka, California specifically cited Proposition 13 as responsible for their not moving to educational computers this year.

While local funding sources predominate, federal and state funding has been utilized effectively in many locations. In some cases ESEA Title monies are used for part of a program, and local monies are used for complimentary portions. In other cases, state monies may also be involved. For example, the General Education Service of the Michigan Department of Education has funded a number of computer projects throughout the state; also utilized in Michigan have been NDEA (National Defense Education Act) and ESEA monies.

Minnesota has provided significant state funds for numerous centers of activity. While originally oriented towards large, centralized systems, the most recent thrust has been towards micro-processor use.

The Dallas Independent School District has implemented their computer programs with 67% of the support garnered from federal grants.

Our present best estimate is that the federal government is only funding about 20% of the installations, and the state governments are only funding about 10%, with Minnesota, Oregon, and Michigan among the leaders. Schools are spending about 20¢ on computer use for each $100 total spent (includes teacher salaries) or about 3½% of the total Instructional Materials budget.

(In some classrooms, the teachers themselves are purchasing low price units with their own money.)

It is apparent that in cases where one funding source is not adequate to meet the needs of a given school system, split funding opportunities are considered. This method is being considered by several BOCES (Board of Cooperative Educational Services). Here both state and local funds may be contributed to a general pool which is then used to purchase computer systems for a number of schools; the approach provides this technology to larger numbers at lower costs. Albany and Binghamton, New York are planning to participate in such a cooperative.

V. TYPES OF COMPUTERS

The nature of the original educational computer market was characterized by the purchase of large centrally operated systems with a large number of peripherals (terminals, etc), or mini-computers. These systems were costly and often required the establishment of complicated time-sharing arrangements among large numbers of users. These facts combined to make computer use inaccessible to the majority of school systems.

Our study has revealed that there are presently 20,000 schools with computer use. But a more significant finding was that 6,000 units were sold or leased in 1979 alone. This big surge of growth, which is expected to continue, is the result of the shift away from large computers to mini and self-contained micros. This new focus has emphasized the fact that educators were waiting for more cost-effective methods, but were essentially eager for computer development. Now, personal computers are here.

Our investigation found examples of both small schools beginning their computer use via micros (e.g. Elk River Senior High School in Minnesota with the purchase of three Radio Shack TRS-80s) and larger systems shifting their existing use to micros (Philadelphia School System and the TIES Network in Minnesota that recently purchased 50 micros). The recent growth in the computer market would not have been accomplished without the introduction of personal computers.

VI. Size of Installations

The growth of micro-computer use has permitted small districts to acquire this technology at a relatively cost-effective price. It was found that the average size of a typical installation is between 3 and 5 terminals, serving 60-100 students.

This was found to be the case at such locations as Elk River Senior High School in Minnesota with three terminals, Clairemont High School in San Diego with five terminals, and Highland Park High School in New Jersey with two terminals. These systems were designed for future expansion as finances and needs require.

The other fairly common size for micro installations was in the five to ten terminal range. This capability was often found in conjunction with a larger machine that was either being phased out or converted to administrative functions only. Lincoln Senior High in Bloomington, Minnesota has several Hewlett-Packard units, but hopes to acquire an APPLE II system, and phase out its dependence on TIES (time sharing education network). Ridgewood High School in New Jersey uses ten DEC terminals, along with an IBM Centralized capability.

Micros are not excluded, however, from the large urban school district market. A few large cities such as Chicago, with 850 terminals, still maintain a fully centralized system. However, our investigation indicates widespread movement from big machines to micros. Dallas has moved to 140 terminals throughout their school system, and Newark, New Jersey recently moved to acquire 30 micros to supplement their centralized system of 64 IBM terminals. The ratio of students-to-terminals at any given school still remains fairly high.

VII. Dollar Expenditures

The cost of a computer installation varies widely depending upon the capabilites and hardware required. Radio Shack markets the lowest price system for approximately $1,000. The larger systems, installed in an entire school district may reach a total expenditure of $400,000, but our survey indicates that the average annual expenditure to user-schools is a modest $9,700. This cost may be reduced if maintanence costs are excluded. The maintanence costs vary for example, Highland Park High School in New Jersey requires only $700 a year for maintenance, and Elk River Senior High School in Minnesota requires $1800 annually.

Despite the small size of this financial commitment relative to the associated public education expenditure per year of about $68 Billion, traditionally only a small percentage is spent on instructional equipments and materials. It is estimated that about $2.00 an hour is now spent on complete support for a public school student. Usually only 3.5% of this is devoted to instructional materials. It is therefore evident that computer costs have to go below $1.00 an hour per student before very many schools could seriously consider this alternative. The introduction of micros has succeeded in bringing this cost down. Though this still represents a significant portion of the instructional materials budget, it is now more feasible as an alternative.

The enthusiasm for computer use has permitted expenditures in this area over what might normally be expected. We found that schools seem willing to invest in CAI-CMI if the incremental costs go up less than 10%. Since this is possible, schools have demonstrated their eagerness for computers by producing an education market figure of $70 Million for basic hardware in 1979.

VIII. Number of Users

Our investigation into computer use in public education reveals that over 20,000 schools currently have this capability. About 15,000 of these schools are high schools. The number of students that have contact with the machines varies depending on the size of the school, size of the installation, and the purpose of the program. Our results indicate on the average that most schools with computers involve over 20% of their total student populations with this teaching aid in some way.

Lincoln Senior High School in Bloomington, Minnesota boasted a 40% user rate within its school, but more common cases were like Palo Alto Unified School District and Boston English High School, reporting with 10% and 8% use by students respectively. Dallas, Texas indicated that they instruct 6,000 students with computer involvement regularly, but even this highly acclaimed program reaches only 5% of the total enrollment. CMI programs often follow over 90% of the school population. It is evident that the area of expansion of existing installations has great market potential for computer vendors.

Our survey found that each year approximately 600,000 high school students and 200,000 elementary students regularly work with or are followed by computers during the course of their studies. However, in all, some 2.3 million public school students have some exposure or at least minor involvement with computers in education programs.

IX. DATA CORRELATION

The bulk of the data presented so far was developed as a result of the survey sent to public educational institutions. However, since our stratified sample was relatively small, in an effort to assess the status of educational computer systems as accurately as possible, our approach also included inputs from computer manufacturers, and software vendors. The results were also corroborated with data from previous studies including those conducted by HJB Enterprises which were presented at the October, 1977 "Computers and the Learning Society" hearings before the U.S. House of Representatives' Committee on Science and Technology.

We did find some relatively minor discrepencies in reporting of dollars spent and equipments purchased between reports given by the manufacturers and the public schools. However, the discrepencies can be accounted for by the different definitions used by these two groups, and by the difference in accounting systems, and items that enter into the determinations. For example, a best estimate of the hardware computer market represented by the public school systems is about $70 Million. However, once this equipment is functioning in the schools, training, instructional support, and related overhead items all enter into the determination of the final computer system budget. In this sense, the schools are spending over $100 Million in association with computing.

We were also interested in attitudinal findings associated with both the schools and the computer system manufacturers and software vendors. Some of these findings will be presented later.

X. Software

As the academic computer becomes a familiar tool, its uses become more responsive to needs of the educational environment. While most schools indicated a desire for system expansion, and an extension of computer capabilities, we also found an important group expanding the use of the present computer system through their own software developments and applications. At Clairemont High School in San Diego, California, the students developed CHACS (Clairemont High Advanced Operating System) which allows for time sharing for up to nine seperate processes. At Ashland Senior High School in Oregon, Huntington II simulations in Social Studies are used; in Rockville, Maryland, a tutorial science career awareness program has been developed, and in numerous locations, staff and students have developed in-house software designed to fill specific local, programming requirements. In some instances, as in the Cincinnati Public School District, such programs have been extended to several thousand students.

Commercial software packaging, however, remains in common use. As computer companies have expanded their efforts in relation to the "school market", many have moved to create programs especially designed for the public schools. Computer literacy curriculum packages were found in use frequently including: TRS-80 II, BASIC, FORTRAN II, COPILOT, and HPACCESS 2000. In mathematics software, Computer Curriculum Corporation (CCC) packaging was popular. The use of ICSP Math programs were also noted. CCC also provides Language Arts programs. DEC has developed O/S8 packages for administrative functions and the GIS system has found its way into schools providing guidance information for students. The Guidance program developed by Educational Testing Service, Princeton, is also being used increasingly. Other software alternatives are being explored as illustrated by Michigan, where a state wide organization (the Michigan Teachers Support System) provides programs for user institutions. Consortium developed software is a highly effective and increasing approach

Sources for software and courseware include:

American Intelligent Machines
Argonaut Information Systems
Automated Bookkeeping
Automated Quill
Bancroft Computer Systems
Burroughs
Cado Systems
California Computer Distributors
California Microcomputer Company
Charles Mann & Associates
Compudata Systems
COMPAL
CompuMax Associates
Cyborg Systems
DAP Systems
Digital Business Systems
Digital Equipment
Hewlett-Packard
Honeywell Information Systems
IBM-General Systems
Interactive Computers
Katcard Systems
Management Science America
MicroSoftware Systems
Midwest Computer Center
NCR
Numeri-Comp
Osborne and Associates
Peachtree Software
Prodigy Systems
Shasta General Systems
Software International
Sperry Univac
Taranto and Associates
UCA Systems

XI. Other Audio-Visual or TV Utilization

It was felt worthwhile to investigate the frequency of computers in educational use with other forms of audio-visual instructional aid. In recent years, audio tapes, films, newspapers, video-tapes, and closed circuit TV have been introduced as learning devices. In our questionnaire we requested data on the use of these devices, as well as computers. We discovered that there is a high positive coorelation between those school districts with computer systems use, and those utilizing additional multi-media aids.

It was common to see examples like Berry Elementary School in Detroit, Michigan with computer use, and separate use of the Borg Warner "System 80" teaching device; and McKinley High School in Washington, D.C. with computers, tape-recording and film available to their students. Obviously, the same general conditions are needed for a school to become involved with either educational computer systems or multi-media individualized instruction.

Schools that already have moved to less traditional educational approaches and curriculum (as Scarsdale, N.Y.) may lead the move toward computers. However, our survey also indicated that even where other approaches are not used regularly (e.g. Dallas, Texas), computers are sometimes effective and found welcome.

It is important to note that a commitment to educational computer use did not precipitate a corresponding move away from other audio-visual methodologies. The need for a full range of instructional aids is retained since they are capable of fulfilling widely diverse functions.

XII. Overall Attitudes

The marked change in attitude toward computers in public education is underscored by the statements of respondents to our survey. Sixty-two percent of the user schools and 67% of the non-user schools responded to attitudinal questions about their computer use. Approximately 80% of this total represented schools with plans for expansion of their computer use. Approximately 85% of user schools said they would recommend computer use to other educational institutions. This is significant since 87% of those without present use anticipate future involvement with this technology. Only 13% still maintain a "no interest position."

These responses reflect an overwhelming acceptance of computers as an educational tool. Questions about the rationale for movement to computer use were met with a variety of responses. Explanations that predominated were: a desire to improve student skills generally, and specifically in logic development and problem solving; a desire to improve instructional techniques; to introduce computer concepts to students; to respond to student and staff interest in this medium; and increased cost-effectiveness. A common theme was the realization that the world's future lies with computers and a responsibility to educate the young to this technology exists. The value computers hold for the instruction of diverse subject material was also emphasized. In Minnesota, the direct positive impact on students' college and professional careers was noted.

The increased acceptance of computers is closely tied to an increased desire for efficiency and lowered costs. The advent of minis and micros signaled the rise of new, more cost-effective systems for use in education settings. The Dallas Independent School District epitomized these findings by noting that in 1979:

> The introduction of the mini-computer encouraged more school districts to experiment with computer-assisted-instruction, but still the cost exceeded $100 per student per year....The introduction of the microcomputer brings the cost of computer-assisted-instruction within the cost range of every school district and every classroom. Using an equipment cost of $1,000 for a microcomputer teaching station, amortizing costs over five years, allowing ten minutes per student per day, the equipment costs per student per year would be $6.67; even including software, the cost per student could still be $10.00 or less.

As a result, a number of school systems are in the process of transition or have completed the replacement of larger systems with micros. Some examples are: Alexis I. DuPont School District, Greenville, Delaware; Denver Colorado School System; Washington, D.C. Public Schools; Philadelphia Public Schools; Boston, Massachusetts School System; the entire TIES Network in Minnesota serving 260,000 students; and Newark, New Jersey.

Additional benefits were seen in the creation of on-going pupil reporting, automated testing, speedier report card procedures, and general administrative tasks. In Minnesota, Elk River North Junior High School's Principal mentioned that there is no longer any doubt that computers are good educational tools. Teachers frequently remarked on their increased availability to individual student's needs and student enthusiasm appears common.

One measure of an instructional devices' effectiveness is the staff's assessment of improved performance among students. Ridgewood, New Jersey; George Washington High School in Denver, Colorado; McKinley High School in Washington, D.C.; Clairemont High School in California; and Highland Park High School in New Jersey; have all indicated noticable improvement. Specific advancement was evident in problem solving techniques in particular. In Dallas, Texas an investigation into sixth graders' math performance revealed that students in CAI classes improved by 1.37 grades in one year. Their counterparts in non-CAI classes showed improvement of 1.06 grades. In addition, all students were given a

difficult post-test on which 10 CAI students scored a grade of "B". Most of the non-CAI students failed the test.

Despite the overwhelming acceptance by students and staff at most public schools, the governing Boards do not always fully share this enthusiasm. Sixty-five percent of our respondents reported that their boards were either supportative, favorable, or shared their positive attitude, but 20% of this group cited financial problems as a complication despite this commitment. Even where successful programs have been implemented, school board attitudes may lag behind. In Dallas, Texas the feeling is described as "skeptical, cautious, and wary." Clairemont, California reports a "cool attitude toward developmental work using micro-computers." There are wide constrasts in attitudes. While Bloomington, Minnesota reports only minimal support, in Palo Alto, California the board has committed itself to a computer project with the express goal of computer literacy for all seventh graders.

Computer use in public schools still seems to be nearing a "period of decision." On the one hand - a great number of schools are forecasting increased computer involvement including expansion into new subject areas and efforts to reach greater numbers of students. The enthusaism for this device is undoubted. On the other hand, school boards are faced with declining budgets, high tax rates, a recession economy, and the presence of reluctant voices. Traditional expectations also need to be revised as evidenced by the attitude at Lincoln Heights Elementary School in Cincinnati, Ohio. They are eager for computers to reach their school, but feel that the Intermediate Schools deserve higher priority.

To assure the most effective targeting of this technology, the effectiveness of computer education at the earliest levels should be emphasized, an area where Federal Guidelines and assistance may be appropriate.

The penetration of computers into elementary schools will represent its complete acceptance as an educational tool and may produce its most effective results. The fact that less than one elementary school in every 16 has any exposure to educational compucers shows that we still have a long way to go.

XIII. Training Arrangements

The success of any computer program is dependent upon the enthusiasm of the instructors responsible for its implementation. Generally, the teachers involved have been instrumental in the development of the computer installation and their cooperation is assured. However, introductory and ongoing training is a necessity that is dealt with in a variety of ways. Scarsdale High School in New York, sends their teachers to Columbia University for on-site training. Elk River Senior High School in Minnesota requires their instructors to attend computer workshops on their own time, and at their own expense. In Washington, D.C., the D.C. Council on Teachers of Math provides in-service training for their new computer teachers at McKinley High School. In Dallas, the school system provides in-house training prior to the school year and at regular intervals throughout the year. At Clairemont High School, no training arrangements are provided so the staff must come prepared, or use their own intitiative for acquiring the necessary skills.

Staff training is a critical facet of computer facility development. The quality and depth of training will determine the effectiveness of programs developed at user schools. However, this crucial function is so dependent on the often scarce financial resources of local districts or even individual teachers. A number of effective programs for computer instructor training and updating have been implemented notably in Dallas Texas' Independent School District. This model may provide guidelines for a federal funding measure to support this crucial activity. The training programs surveyed survive despite poor funding and the present lack of federal monies. Instead the teachers have pooled resources, utilized professional associations, and spent personal funds.

XIV. Computer Sales, Manufacturers, and Attitudes

As noted, about $70,000,000 worth of computers and peripheral support unit sales were made to the U.S. public schools in the past year. The sale of computers to educational institutions is usually the result of careful shopping by informed personnel for the the system that fulfills their school's needs. Exploration is usually made with several vendors. Though this procedure is not likely to alter drastically, the increased availability of systems allows for new kinds of decision making.

Texas Instruments, Tandy-Radio Shack and others have lead the way for computer vendors who would like to implement a new approach to marketing. Instead of listening to sales people with brochures, it is now possible to shop for computers by going from store to store. Radio Shack originally announced plans to add computer centers to 50 of their retail outlet stores. On July 9, 1979, they announced that these stores will be joined by 100 others. Texas Instruments has launced a new marketing campaign with their systems available at computer stores, electronic speciality stores and general department stores.

Though it is common for a small number of computer stores specializing in computers only, to be present in urban areas, it appears that the acquisition of computers along with the sale of other electronic equipment may become popular. When this practice becomes widespread, adminstrators and instructors will need only go to their local computer store to view the full range of available computer equipment.

Manufacturers of computers and public school teachers and administrators generally feel that the R&D period for evaluating educational computers is largely behind us, and that the role of the Federal Government should be to assist with "implementation and training programs." Few have detailed ideas as to exactly how this could be done.

Some of the manufacturers and corporations involved with educational computers, are concerned about the "Regulatory Role" of the Federal Government. The recent acquisition of Telenet Communication Corporation by the General Telephone and Electronics Corporation saw a swing in federal position which finally allowed the acquisition. Similarly, Texas Instruments, Incorporated has been trying, thus far without success, to modify the FCC regulations so as to be able to market a lower cost computer terminal which would attach to any TV set for display.

Texas Instruments, Inc. is now launching the "99/4" personal computer, but will direct its sales at the "home market", and let the units only indirectly diffuse into the public schools. It took that approach with portable electronic calculators, and has found that almost 50% of all such units used in schools were originally manufactured by Texas Instruments.

Several of the original manufacturers of CAI systems expressed disappointment over the "lack of federal support." They "sponsored a lot of research, but were unwilling or unable to take a stand - after the positive results were in." Again, the general desire is for programs that can support the "Implementation Stage". It was felt by many of the "micro-processor" manufacturers, that wide-spread programs teaching "Computer Literacy" should be federally sponsored.

It is estimated that about $70,000,000 worth of educational computers and peripherals were sold to the public schools over the past year. Since most of the new sales are smaller mini-systems and microprocessors, this

resulted in about a 25% expansion of the number of public school students using educational computers.

The policy and role of the federal government in the 1980's will be a very important one in influencing how educational computers affect the public schools.

XV. STATES WITH "INCREASING" COMPUTERS IN EDUCATION USE

North East

New Hampshire
Massachusetts
Connecticut
New York
New Jersey

North Central

Ohio
Michigan
Wisconsin
Illinois
Minnesota
Iowa
Kansas

South

Maryland
North Carolina
Florida
Texas
Virginia

Far West

Calfiornia
Oregon
Utah
Clorado
Arizona
Hawaii
Alaska

&
Washington, D.C.

XVI. Conclusions

- The introduction of microprocessors has enabled an expansion of educational computing in the nation's public schools. About 3½% of the Instructional Materials budgets now goes for educational computers.
- Secondary schools have witnessed a dramatic growth of use of student management and educational computing, to the extent that about 3/4 of all public high schools are now involved, and some 28% offer data processing courses.
- CAI is used mostly for teaching Math and Computer Science.
- There has also been an increase of CAI in the elementary schools; over 20,000 computers are now in the public schools.
- About 70% of the programs are supported with local funds; and only about 20% with federal funds.
- There is a need for more federal support of Implementation Programs, Teacher Training, and Computer Literacy Courses.
- There has been a dramatic decrease of teacher "anti-computer" attitudes over the past decade.
- In 1979 the public education community produced a computer market worth $70,000,000.
- Computer-Managed-Instruction uses have also expanded, increasing testing capabilities for a wide variety of applications.
- The educational computer market has good potential for continued growth in the 1980's; particularly since large numbers of elementary school students still remain unexposed to the benefits of this technology.

WLC, INC.

333 MONTGOMERY STREET
HIGHLAND PARK, NEW JERSEY 08904
201-828-9333

APPENDICIES

HJB ENTERPRISES

WLC, INC.

333 MONTGOMERY STREET
HIGHLAND PARK, NEW JERSEY 08904
201-828-9333

Dear

The WLC, Incorporated unit of HJB Enterprises has undertaken a survey of school computer systems for the National Institute of Education (NIE). We would like to ask for the assistance of your institution.

NIE is interested in determining the number of computer systems currently in educational use, and the projected estimates for the future. In order to compile this data we are requesting that you complete the enclosed questionnaire carefully and comprehensively.

Please complete the form regardless of the amount of computer use in your specific situation. An accurate assessment of computers in education can only be made with a full accounting of all attitudes, expectations, and applications (both administrative and instructional).

This effort to assess the computer penetration of schools will provide crucial information for the more effective use of this technology in the future, We are requesting that you take a small amount of your time to assist in this endeavor.

If you have any questions please call us. Thank-you for your cooperation.

Yours sincerely,

Harvey J. Brudner

Encl: Questionnaire
HJB/kf

HJB ENTERPRISES

WLC, INC.

333 MONTGOMERY STREET
HIGHLAND PARK, NEW JERSEY 08904
201-828-9333

Dear

The WLC, Incorporated unit of HJB Enterprises has undertaken a survey of school computer systems for the National Institute of Education (NIE). We would like to ask for the assistance of your organization.

NIE is interested in determining the number of computer systems currently in educational use, and projected estimates for the future. In order to compile this data we are requesting sales figures and estimates for the 1978-81 period. Specifically, we would like total computer sales figures, and the percentage of the total which were sold to educational institutions. The latter data should include Computer-Assisted-Instruction systems, as well as Computer-Managed-Instruction, and any computers used for administrative purposes.

We realize that this data is sometimes difficult to obtain since sales records may not be organized to facilitate identification of the educational market, however NIE feels that this trend of increased computer use in schools is important, and should be accurately assessed. Any information you can provide to further this effort will be appreciated.

If you have any questions please call us. Thank-you for your cooperation.

Sincerely,

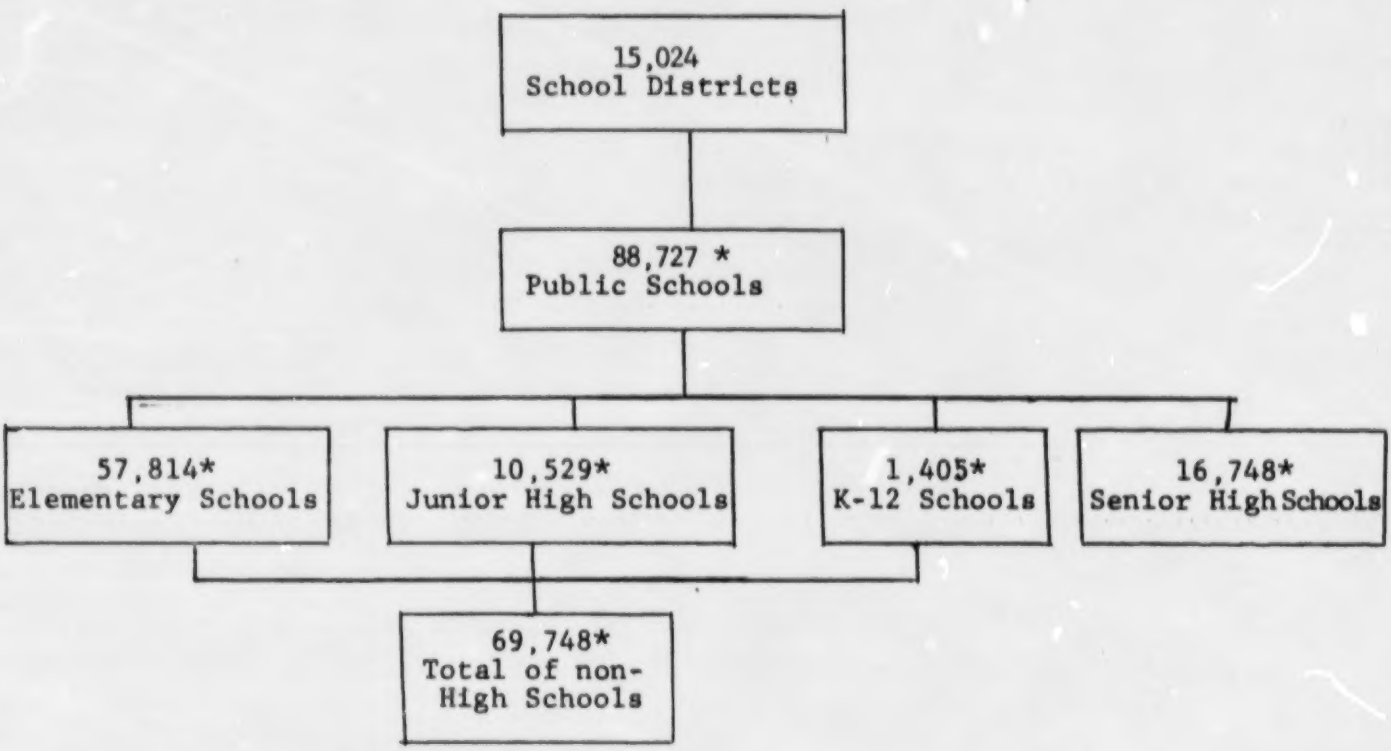
Harvey J. Brudner

HJB/kf

Approximate

Structure and Breakdown of Public School System

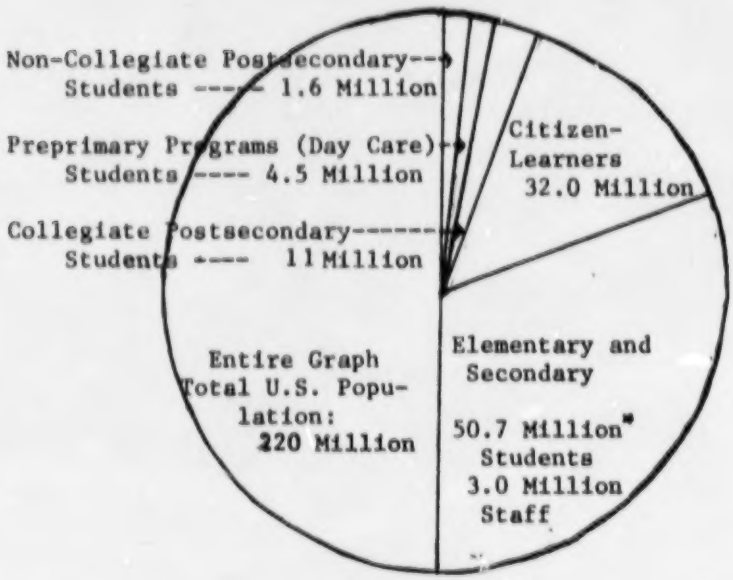
Number of Schools[1]



* These numbers will be rounded off to the nearest thousand for future calculations.

1. Market Data Retrieval: "1979-80 Educational Mailing Lists", p.2.

Approximate
Enrollments and Expenditures[2]



*Approximately 20% of these students attend non-public institutions bringing the total enrollment population of PUBLIC elementary and secondary schools to 40 Million.

Average total expenditures for instructional materials only:

School level	$/student/year	$/school/year
Elementary	$8.00	$17,543
Junior High	$16.00	$30,441
High School	$31.00	$40,734
TOTAL		$2,000,000,000/annually

The average total expenditure per student regardless of grade level is approximately $1,700/year. This figure produces total school expenditures in the area of $68 Billion. Therefore, approximatley 3.5% of total school costs are devoted to Instructional Material.

2. Market Data Retrieval:"1979-80 Educational Mailing Lists" and "Staffing the Learning Society: Recommendations for Federal Legislation"National Advisory Council on Education Professions Development.

Computer Manufacturing Companies

Apple Computer Incorporated
Applied Digital Communications, Inc.
Basic Four Corporation
Burroughs Corporation
Commodore
Computer Automation Inc.
Computer Data Access, Inc.
Control Data Corporation
Data General Corporation
Data Point Corporation
Diablo Systems, Inc.
Digital Equipment Corporation
Digital Scientific Corporation
Educational Data Systems, Inc.
Gemini Information Systems, Inc.
Hewlett-Packard Company
Honeywell Information Systems, Inc.
IBM Corporation
ITEL Corporation
IMSAI
Intelligent Systems Corporation
Lear Siegler, Inc.
Microdata Corporation
Mini-Computer Systems, Inc.
NCR Corporation
NEC Information Systems
Nixdorf Computer Corporation
Ohio Scientific, Inc.
Perkin-Elmer Corporation
Problem Solver Systems, Inc.
QI Corporation
Raytheon Data Systems
Scientific Data Systems, Inc.
Spectrum Computer Systems, Inc.
Sperry-Univac Corporation
Tandy Radio-Shack
Texas Instruments, Inc.
TWO PI Corporation
Varian Associates
Wang Laboratories
Tektronix
Xerox Corporation

Newark board ex... computer drill program

By JASON JETT

Expansion of a computer drill program to several high schools this fall has been announced by the Newark Board of Education in what it calls an effort to improve basic skills among students.

During the past six years, the program has shown success in raising the math and reading skill levels of participating elementary and junior high school students, according to studies and evaluations conducted by the board.

However, a 1975-76 evaluation found problems with the program in its preliminary use in a Newark high school. In that evaluation of he computer drill program at Central High School, the board recommended that the program not be expanded to other high schools.

Recently, the computer program director at Central High, Theodore Pinkney, reported that problems such as "student disinterest" and "poor accommodations" have been alleviated, and the board has decided to add the program at Science, University, East Side and West Side high schools.

According to Vic Thomas, director of school computer service, past problems were caused by outdated and oversimplistic materials. He said newer materials that are more challenging to students brought on the improvement at Central and should be successful at the other schools.

• • •

The program, called computer assisted instruction, involves students in the use of computers as mechanisms for executing drills in language arts, math and reading.

The chief advantage of the program, school officials said, is that it individualizes students' work and allows teachers to devote more time to more students.

They said the computer gives tests to assess the skills of a student and then offers exercises on that particular level. The computer gradually raises or lowers the difficulty of the problems according to the student's performance, they added.

School officials said the program allows teachers to direct the work of students without having to supervise them constantly. While a student is working at his particular skill level at a computer, the teacher can assist another whose skills may be lower or higher, they said.

• • •

The officials were quick to note that the computers were to intended to replace teachers.

"If you sit down at the machine, it is never going to teach you how to do multiplication," said Thomas. "Once the concept is introduced by the teacher, the computer provides the mechanism of allowing every child to get as much practice as is necessary at his individual level."

Numerous school systems throughout the country have reported success with computer-assisted instruction programs including those in Hempstead, N.Y. and Freeport, N.Y.

• • •

The board of education also plans to expand a "computer literacy" program which currently instructs students at Malxolm X Shabazz High School in data processing and keypunch.

The program is to be added at Science, University and West Side this fall.

Also by the fall, school officials hope to begin a computer-assisted instruction program in Portuguese and include adult education classes in the basic skills program.

The computer assisted instruction network in Newark schools presently consist of 78 computer terminals at ten schools.

The program is in operation at Cleveland, Avon Avenue, Bragaw Avenue, Lafayette, and Horton elementary schools and West Kinney, Broadway, Clinton Place and Webster junior high schools, along with Central High School.

Photo by Cary Herz

a senior at Shabazz High, watches her instructor, Erma ..., check computer print-out evaluation of her work